What is claimed is:

1. A method for depositing a material on a substrate, the method comprising:

placing a substrate in a chamber having a plasma source and on a substrate holder;

depositing a Tunable Etch Resistant ARC (TERA) layer on the substrate, wherein a processing gas comprising a precursor is provided to the chamber; and

exposing the TERA layer to a post-processing plasma, wherein a photoresist-compatible surface is created on the TERA layer.

2. The method as claimed in claim 1, further comprising:

forming a plurality of photoresist features on the photoresist-compatible surface of the TERA layer, wherein at least one of the photoresist features comprises a substantially small foot.

3. The method as claimed in claim 1, further comprising:

forming a plurality of photoresist features on the photoresist-compatible surface of the TERA layer, wherein at least one of the photoresist features comprises a well-defined rectangular profile.

4. The method as claimed in claim 1, wherein the exposing includes:

creating the post-processing plasma using at least one of an oxygen-containing gas and a hydrogen-containing gas.

5. The method as claimed in claim 4, wherein the oxygen-containing gas is employed during the creating, flowing at a rate ranging from approximately 0.0 sccm to approximately 10000 sccm, and the oxygen-containing gas comprises at least one of H_2O, NO, N_2O, O_2, CO, and CO_2.

6. The method as claimed in claim 4, wherein the hydrogen-containing gas is employed during the creating, flowing at a rate ranging from

approximately 0.0 sccm to approximately 10000 sccm, wherein the hydrogen-containing gas comprises at least one of H_2O and H_2.

7. The method as claimed in claim 4, wherein an inert gas is also employed during the creating, flowing at a rate ranging from approximately 0.0 sccm to approximately 10000 sccm, wherein the inert gas comprises at least one of Ar, He, and N_2.

8. The method as claimed in claim 1, wherein the plasma source has an RF source and the exposing further comprises:

operating the RF source in a frequency range from approximately 0.1 MHz. to approximately 200 MHz; and

operating the RF source in a power range from approximately 0.1 watts to approximately 200 watts.

9. The method as claimed in claim 1, wherein the post-processing plasma has a lifetime time that varies from approximately 2 seconds to approximately 180 seconds.

10. The method as claimed in claim 1, wherein the depositing the TERA layer comprises:

depositing a bottom portion of the TERA layer during a deposition time, wherein the bottom portion comprises a material having a refractive index (n) ranging from approximately 1.5 to approximately 2.5 when measured at a wavelength of at least one of: 248 nm, 193 nm, and 157 nm, and an extinction coefficient (k) ranging from approximately 0.10 to approximately 0.9 when measured at a wavelength of at least one of: 248 nm, 193 nm, and 157 nm.

11. The method as claimed in claim 10, wherein the depositing of the bottom portion occurs at a rate from approximately 100 A/min to approximately 10000 A/min.

12. The method as claimed in claim 10, wherein the deposition time ranges from approximately 5 seconds to approximately 180 seconds.

13. The method as claimed in claim 10, wherein the plasma source has an RF source and the depositing of the bottom portion further comprises:

operating the RF source in a frequency range from approximately 0.1 MHz. to approximately 200 MHz; and

operating the RF source in a power range from approximately 10.0 watts to approximately 10000 watts.

14. The method as claimed in claim 13, wherein a second RF source is coupled to the substrate holder and the depositing of the bottom portion further comprises:

operating the second RF source in a frequency range from approximately 0.1 MHz. to approximately 200 MHz; and

operating the second RF source in a power range from approximately 0.0 watts to approximately 500 watts.

15. The method as claimed in claim 10, wherein the depositing of the bottom portion further comprises:

providing the process gas, wherein the process gas comprises at least one of a silicon-containing precursor and a carbon-containing precursor.

16. The method as claimed in claim 15, wherein the providing of the process gas comprises flowing the silicon-containing precursor and/or the carbon-containing precursor at a first rate ranging from approximately 0.0 sccm to approximately 5000 sccm.

17. The method as claimed in claim 15, wherein the processing gas comprises at least one of monosilane (SiH_4), tetraethylorthosilicate (TEOS), monomethylsilane (1MS), dimethylsilane (2MS), trimethylsilane (3MS), tetramethylsilane (4MS), octamethylcyclotetrasiloxane (OMCTS),and tetramethylcyclotetrasilane (TMCTS).

18. The method as claimed in claim 15, wherein the processing gas comprises at least one of CH_4, C_2H_4, C_2H_2, C_6H_6 and C_6H_5OH.

19. The method as claimed in claim 15, wherein the process gas includes an inert gas comprising at least one of argon, helium, and nitrogen.

20. The method as claimed in claim 10, wherein the depositing of the bottom portion further comprises:

controlling chamber pressure using a pressure control system, wherein the chamber pressure ranges from approximately 0.1 mTorr to approximately 100 Torr.

21. The method as claimed in claim 20, wherein the chamber pressure ranges from approximately 0.1 Torr to approximately 20 Torr.

22. The method as claimed in claim 10, wherein the depositing of the bottom portion further comprises:

providing a DC voltage to an electrostatic chuck (ESC) coupled to the substrate holder to clamp the substrate to the substrate holder, wherein the DC voltage ranges from approximately -2000 V. to approximately +2000 V.

23. The method as claimed in claim 1, wherein the depositing of the TERA layer further comprises:

depositing a top portion of the TERA layer during a deposition time, wherein the top portion comprises a material having a refractive index (n) ranging from approximately 1.5 to approximately 2.5 when measured at a wavelength of at least one of: 248 nm, 193 nm, and 157 nm, and an extinction coefficient (k) ranging from approximately 0.10 to approximately 0.9 when measured at a wavelength of at least one of: 248 nm, 193 nm, and 157 nm.

24. The method as claimed in claim 23, wherein the plasma source has an RF source and the depositing of the top portion further comprises:

operating the RF source in a frequency range from approximately 1 MHz. to approximately 100 MHz; and

operating the RF source in a power range from approximately 10.0 watts to approximately 2000 watts.

25. The method as claimed in claim 23, wherein depositing of the top portion occurs at a rate from approximately 10 A/min to approximately 5000 A/min.

26. The method as claimed in claim 23, wherein the deposition time ranges from approximately 5 seconds to approximately 180 seconds.

27. The method as claimed in claim 23, wherein the process gas for the top portion comprises an inert gas, and a precursor that includes silicon, carbon and oxygen.

28. The method as claimed in claim 23, wherein process gas for the top portion comprises a silicon-containing precursor, a carbon-containing gas, an oxygen-containing gas, and an inert gas.

29. The method as claimed in claim 27, wherein the precursor is flowed at a first rate ranging from approximately 0.0 sccm to approximately 5000 sccm, and the inert gas is flowed at a second rate ranging from approximately 0.0 sccm to approximately 10000 sccm

30. The method as claimed in claim 27, wherein the precursor comprises at least one of tetramethylcyclotetrasilane (TMCTS) tetraethylorthosilicate (TEOS), dimethyldimethoxysilane (DMDMOS), and octamethylcyclotetrasiloxane (OMCTS).

31. The method as claimed in claim 27, wherein the inert gas comprises at least one of argon, helium, and nitrogen.

32. The method as claimed in claim 1, further comprising controlling a temperature of the substrate.

33. The method as claimed in claim 32, wherein the substrate temperature ranges from approximately 0° C. to approximately 500° C.

34. The method as claimed in claim 1, further comprising controlling a temperature of at least one chamber wall of the chamber.

35. The method as claimed in claim 34, wherein the temperature of the at least one chamber wall ranges from approximately 0° C. to approximately 500° C.

36. The method as claimed in claim 1, wherein a shower plate assembly is coupled to the chamber and the method further comprises:

controlling a temperature of the shower plate assembly.

37. The method as claimed in claim 38, wherein the temperature of the shower plate assembly ranges from approximately 0° C. to approximately 500° C.

38. The method as claimed in claim 1, further comprising:

de-chucking the substrate while the post-processing plasma is being created.

39. The method as claimed in claim 1, further comprising:

de-chucking the substrate before the post-processing plasma is created.

40. The method as claimed in claim 1, further comprising:

de-chucking the substrate after the post-processing plasma is extinguished.

41. The method as claimed in claim 1, further comprising:

lifting the substrate while the post-processing plasma is being created.

42. The method as claimed in claim 1, further comprising:
lifting the substrate before the post-processing plasma is created.

43. The method as claimed in claim 1, further comprising:
lifting the substrate after the post-processing plasma is extinguished.